DOCUMENT RESUME

ED 090 054 SE 017 733

AUTHOR Hunt, John D.; Lamkin, Bill
TITLE An Analysis of Reinforcement and Feedback within an Auto-Tutorial Plant Taxonomy Module.
PUB DATE Apr 74
NOTE 10p.; Paper presented at the annual meeting of the National Association for Research in Science Teaching (47th, Chicago, Illinois, April 1974)

EDRS PRICE MF-$0.75 HC-$1.50 PLUS POSTAGE
DESCRIPTORS Academic Achievement; *Autoinstructional Programs; Biology; Cognitive Measurement; *Educational Research; *Feedback; Instructional Programs; *Secondary School Science; Secondary School Students
IDENTIFIERS Research Reports

ABSTRACT

This study involved the use of an auto-tutorial system (plant taxonomy module) and its effect on cognitive learning. Student performance was investigated and compared for two groups, one of which received immediate reinforcement and feedback while the other group did not. Two biology teachers, from a group of 14, were randomly selected to participate in the study. Two groups of 24 students were randomly chosen from two lists of 150 students in the classes of these teachers. The first 24 students were the control group. Pre- and posttests containing 25 multiple choice responses were used to measure student performance. Data were analyzed using a multiple linear regression program. The investigators found (1) the I.Q. (obtained from data on the California Test of Mental Maturity in school records) of the students produced a significant difference in cognitive gains in both systems, and (2) the system employing immediate reinforcement and feedback produced significant and greater gains in cognitive learning than did the system without immediate reinforcement and feedback. (Authors/PEB)

ED 090054

U S DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

An Analysis of Reinforcement and Feedback within an Auto-Tutorial Plant Taxonomy Module*

John D. Hunt

University of Northern Colorado, Greeley, Colorado 80631

and

Bill Lamkin

Baylor University, Waco, Texas 76703

* This study was financed by a research grant from the Western Institute for Science and Technology, Waco, Texas.

SE 017 733

INTRODUCTION

On reviewing the research conducted on audio-tutorial systems during the past decade it has been found that more research is necessary with variables within this mode of instruction. DeCecco found that students expect reinforcers for their efforts, whether or not they are correct.[1] Hilgard and Bower state that positive reinforcement, such as rewards and successes are more acceptable in student achievement than negative reinforcements, such as punishments and failures.[2] Thurber and Collette state that immediate reinforcement for a correct response in science should not be used.[3] Lumsdaine reports that despite an enormous amount of literature on reinforcement in learning, relatively few experiments have studied reinforcement factors systematically as they apply to practical instruction.[4]

In reference to audio-tutorial methods, Novak states that the research has been very minimal. He states:

> Those studies that attempt to contrast audio--tutorial approaches to instruction versus traditional approaches are most certainly comparing apples and eggs. The crucial variable in such a contrast is not whether students under one instructional approach acquire more knowledge than under the other instructional approach but rather the analysis of learning time required to reach a given level of attainment . . . .[5]

The gaps that occur in research, indicate the need for studying variables within the audio-tutorial paradigm.

THE PROBLEM

The problem of this study, was to evaluate the effect on cognitive learning of an auto-tutorial system. An auto-instructional system is a self--instructional, independent mode of learning through the aid of a cassette tape recorder and visual devices. It is a structured lesson which Ausubel advocates because it leads to highly meaningful learning of concepts.[6]

In dealing with this problem, an analysis was made of various variables within this system, such as immediate reinforcement and feedback versus no immediate reinforcement and feedback.

PURPOSE OF THE STUDY

The purpose of this study was to compare the performance of students receiving immediate reinforcement and feedback within an auto--tutorial system to the performance of students in the same system but not receiving immediate reinforcement and feedback.

DESCRIPTION OF THE EXPERIMENT

In the development of the auto-tutorial system, the first step was the writing of instructional objectives in the behavioral mode. These behavioral objectives were: (1) The student will be able, at the completion of the module, to identify in writing types of inflorescences used in plant taxonomy; (2) The student will be able, at the completion of the module, to identify in writing selected vegetative structures, such as leaves and leaf arrangement on a plant axis; and (3) The student will be able, at the completion of the module, to identify in writing unknown plant specimens by the use of dichotomous keys.

The second step in the module development concerned the amount of knowledge the student possessed before he started the module, which was determined by means of a pretest of the paper-pencil type. This test contained fifty multiple choice questions which used concepts based on those used in the system. The third step in developing this system was the writing of the script and assembling the appropriate materials. The instructions were incorporated into the script and then recorded on an audio-cassette. Slides, worksheets, and living plant specimens complemented the audio aspect of the module. The fourth step concerned the assessment of the students knowledge gained after he had finished the module. This was determined by a post test of the paper-pencil type. Both pretest and post test were the same. Twenty-five 35mm ektachrome slides, eight worksheets, ten living specimens, and a pre- and post test were submitted, by the primary author, on a pilot basis to thirty tenth grade biology students at Stephen F. Austin High School in Port Arthur, Texas, during the 1969-70 school year. After the students

had completed the pilot auto-tutorial system, their responses on the work-sheets, and test responses were analyzed. It was found that the script and cognitive test were too long for this age student, and the student relied too much on the classroom teacher. A revised script and written test were submitted and used by students in the Waco Independent School District, Waco, Texas, between April 2, 1973, and April 19, 1973.

The revised script was written so that the student would be able to follow the directions without any help from his classroom teacher. The student was instructed on the script to look at a slide or a series of slides to find the one that best matched the live specimen he was using. All of the specimens were provided for the student by the writer and included leaves and inflorescences. The responses chosen by the student were recorded in a workbook. The following worksheets were included in this workbook: a leaf analysis sheet, a dichotomous key on leaves, an inflorescence worksheet, and a key to inflorescences.

Two scripts were written for the investigation using the above model as the basic design. The scripts for students in the control group contained no immediate reinforcement or feedback. The script for the students in the experimental group contained immediate reinforcement and feedback for each response. The feedback used in this script was to tell the student the answers to the questions. Praise and encouragement, such as "That's right," "You are doing a great job," "great" and "excellent" were used as immediate reinforcement. All of the scripts were recorded on cassette tapes. A pre-test and post test containing twenty-five multiple choice responses were used. The pretest was administered to each student prior to the start of the

module, and a post test was given to each student immediately following the completion of the system. Students in both groups experimental and control, had the same paper-pencil test. The other items included in the system for both groups of students were as follows: a glossary on taxonomic terms of leaves, a glossary on taxonomic terms pertaining to flowers, slide sequence sheets, and 2 x 2 slides. Eight identical systems were produced for the control group and another eight identical systems were developed for the experimental group and all systems were developed for the experimental group and all systems were used at one time during the students' scheduled biology period. A randomized control group pretest, post test design was used in this study.[7] The teachers and students were selected at random.

SELECTION OF TEACHERS

Fourteen teachers of biology in grades nine and ten of the Waco Independent School District, Waco, Texas, were asked to participate in this study. The two teachers, selected at random, were two who taught tenth grade biology at Richfield High School in Waco, Texas.

SELECTION OF SUBJECTS

In the selection of the students, two class rolls containing the names of 150 students from the two teachers selected were given to the primary researcher. The first twenty-four students, randomly picked, formed the control

group, and the remining twenty-four formed the experimental group. In the control group there were seventeen boys, and in the experimental group there were sixteen girls. Black, Mexican-American, and white students participated. I.Q.s were obtained from the California Test of Mental Maturity, which was given to the students during November, 1972.

FINDINGS OF THE STUDY

An analysis was made using a multiple linear regression program LINEAR[8] of the following two hypotheses.

> Null hypothesis 1. There is no significant difference between the residual gain scores by the two groups in cognitive knowledge about wild flowers and their parts in reference to the groups variable I.Q. as measured by the California Test of Mental Maturity.

A multiple linear regression analysis was used to determine whether the student's I.Q. made any difference in the residual gain in the score on the post test. In full model number I the group and I.Q. identification of each group was treated separately and was compared to a restricted regression model I in which the groups remained separated but the I.Q. variable was considered in common. For example,

$$\text{FULL MODEL I} \quad Y = a_1 G^1 + a_2 G^2 + c_1 I^1 + c_2 I^2 + E$$

where Y= residual gain scores obtained from the pretest and post test of the control and experimental group

G^1= "1" if member of experimental group, "0" otherwise

G^2= "1" if member of control group, "0" otherwise

I^1= I.Q. of students, "1" if member of experimental group, "0" otherwise

I^2= I.Q. of students, "1" if member of control group, "0" otherwise

a,c,= assigned weights

and E= error (regression constant)

RESTRICTED MODEL I $Y = a_1 G^1 + a_2 G^2 + c_0 I^0 + E$

When 1 and 44 degrees of freedom were employed in this analysis, an F-value of 4.10 was obtained, and this value was found to be significant at the .05 level of confidence. This finding permitted the conclusion that the students' I.Q.s were making a significant contribution to the prediction of the residual gain in score on the post test.

Another regression analysis was undertaken where the restricted model I was compared to a restricted model II to determine whether the students' I.Q.s made any difference in score on the post test. In the restricted regression model I the groups were separated, but the I.Q. variable of both treatment groups were consolidated. In regression model II the treatment groups were separated, and the I.Q.s of both groups were omitted.

RESTRICTED II $Y = a_1 G^1 + a_2 G^2 + E$

When 1 and 45 degrees of freedom were used, an F-value of 6.61 was significant at the .01 level. It was concluded that the I.Q. did have an effect on the students' residual gain in score on the post test.

Null hypothesis 2. There is no significant difference between the residual gain scores made by the two groups in cognitive knowledge about wild flowers and their parts in reference to immediate reinforcement and feedback.

A multiple linear regression analysis was used to determine if there

was a relationship between the residual gains in score made by the two groups as a result of the program. A regression model, with I.Q. and group membership separated, was used and compared to a model where both the I.Q. and group membership were cojoined. When 2 and 44 degrees of freedom were employed, an F-value of 6.05 was found to be significant at the .01 level. It was concluded, therefore, that group membership and I.Q. made a significant difference in the residual gains in score; therefore, it may be inferred that the program employing immediate reinforcement and feedback did make a significant difference and those with higher I.Q.s made the greater gains.

CONCLUSIONS

In two auto-tutorial systems, one of which employs immediate reinforcement and feedback, the following conclusions may be stated: (1) the I.Q. of the students produced a significant difference in cognitive gains in both systems; and (2) the system employing immediate reinforcement and feedback produced significant and greater gains in cognitive learning than the system without immediate reinforcement and feedback. Based on data available from forty-eight students the self-instructional system of immediate reinforcement and feedback was more effective for cognitive learning than a system containing no immediate reinforcement and feedback.

REFERENCES

1. DeCecco, John P., The Psychology of Learning and Instruction: Educational Psychology, Prentice-Hall, Inc., Englewood Cliffs, N. J., 1968.

2. Hilgard, Ernest R., and Bower, G.H., Theories of Learning, Meredith Publishing Company, New York, 1966.

3. Thurber, Walter A., and Collette, Alfred T., Teaching Science in Today's Secondary Schools, Allyn and Bacon, Inc., Boston, 1968.

4. Lumsdaine, A.A., "Experimental Research on Instructional Devices and Materials," Training Research and Education. Edited by Robert Glaser, University of Pittsburgh Press, Pittsburgh, 1962.

5. Novak, J.D., "Relevant Research on Audio-Tutorial Methods." School Science and Mathematics, 70, 777-784, 1970.

6. Ausubel, David P., Educational Psychology: A Cognitive View, Holt, Rinehart and Winston, Inc., New York, 1968.

7. Van Dalen, Belbold B., Understanding Educational Research, McGraw-Hill Book Company, New York, 1966.

8. Jenkins, Earl, "EDSTAT-J; A Subroutine System for Data Processing in the Behavioral Sciences," Department of Educational Psychology, College of Education, University of Texas at Austin, February, 1971. (mimeographed.)